ON THE ISSUE OF ASSESSMENT OF ECOLOGICAL STATUS AND POTENTIAL OF THE WATER BODIES WITH DIFFERENT TIPE AND INTENSITY OF ANTHROPOGENIC IMPACT

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Currently, the process of implementation the principles of the EU Water Framework Directive/2000 into the aquatic quality assessment system is underway in Ukraine. In the EU Member States, for example in Poland, these approaches have already been implemented to some extent, but the process of implementation is still underway in Ukraine. However, the practical application of the general principles of the WFD is not easy, because the significant predominance of justifications there is, studies specifically for the assessment of natural reservoirs, with little anthropogenic impact (rivers, lakes). There are practically no approaches that may be used as a universal tools for assessments of the ecological quality of natural lentic waters and water flows, as well as the ecological potential of anthropogenic waters.There is no well-developed concept for the formation of this complete gradient of water bodies – from natural, undisturbed man – to technoecosystems, completely created for technical (technological) needs.

The Water Framework Directive formally is a comprehensive document in the field of water protection, but in fact it is an important instrument of a broader plan and it is related to the use of aquatic ecosystems and the provision of so-called environmental services. The conceptual position is follows: if the ecological status of a natural water body is high, the ecological potential of the artificial too, the more efficient environmental services for man are provided by such an ecosystem (Uzunov, Protasov, 2018, Afanasyev, 2019). From this we can conclude that hydrobiological, ecosystem studies should be the basis for the development of adequate methodologies and methods for assessing the quality of the environment.

Another need for the introduction of new approaches in valuation activities is related to the fact that techno-ecosystems such as techno-ecosystems of thermal power plants, as well as cooling ponds of nuclear power plants, are a very important models for studying the effects of climate change, in particular, processes associated with an increase in temperature.

Analysis of long-term data and obtaining new data allows us to establish a certain focus on the formation of the structure and functioning of hydroecosystems under anthropogenic pressure against the backdrop of changing climatic factors. An applied and socially significant aspect of these studies are recommendations for using of new hydrobiological approaches in the practice of assessment of the ecological status and ecological potential of various types of water bodies.

When considering issues related to differences in the approaches to assessing the ecological status and ecological potential, it is necessary to take into account the peculiarities of the structure and functioning of techno-ecosystems.

We assume following: from the point of view of the general biotopic structure of the ecosystem, the presence of «techno» elements (water supply constructions, tubes, dams) are quite equivalent to the elements «geo», that is, natural (water, sediments, stones, rocks, vegetation). Although they certainly have their own biotopic features. Technical systems are simple, partial- and extra-causal systems, and oppositely biological systems are complex, fully- and inter-causal systems (Mikhailovsky, 1984).The first ones have a rather limited number of elements, are quite predictable in their behavior, their structure and functions can be described at the element level, their structure is determined externally by humans, and depends on technical aims. The second ones have opposite characteristics. It is obvious that the techno-ecosystem, which consists of various types of subsystems, will have «mixed» properties that will depend on the ratio of the elements of the subsystems.

The ratio of natural and technical elements in the techno-ecosystem depends on its structure. In the cooling system of nuclear power plants with a closed cycle and cooling towers, technical elements

essentially dominate. In a system with a cooling pond, elements that are close to natural ones predominate.

Currently, there is a significant reconstruction of the fundamentals and system of water management, both in Europe and in Ukraine. But these changes does not always happen harmoniously from an ecological point of view. In the documents of the Ukrainian regulatory rules relating to the implementation of the EU Water Framework Directive absent the provision that for heavily modified water bodies, as well as for artificial (including techno-ecosystems) there are not only environmental, but technical targets. Exactly the concept of the techno-ecosystem connect these goals into one set. The absence in the new regulatory documents of the Ministry of Ecology of Ukraine of the concept and term «water body/water object» (lentic or lotic), the presence only the term «surface water masses» (Ukrainian: масив поверхневих вод), leads to the fact that only water masses are considered in isolation from other abiotic elements of the water ecosystems. This is violation of the fundamental principle of the unity of the water ecosystem. The thesis about the possibility of equating highly modified reservoirs with «similar» natural ones is also ecologically unacceptable. Moreover, it is unacceptable for techno-ecosystems. To evaluate them according to the principle of comparison with the «standard» reference, it is necessary to develop such a set of both environmentally and technically acceptable conditions that would allow obtaining adequate estimates.

The growing scale and role of techno-ecosystems (as well as agro-and urban-ecosystems) sets the task of typing them, developing principles and methods of control. It is necessary to consider the following provisions and principles. Techno-ecosystems are not fundamentally different from natural ones, their biotopic structure is only supplemented by anthropogenic elements, which, however, can substantially replace natural ones. At the same time, techno-ecosystems are created to perform certain tasks, therefore, when evaluating of their potential should take into account not only environmental objectives (minimizing their impact on other ecosystems and human), but also technical ones. In practice, we are talking about the provision of environmental and techno-ecosystem services. This target bifurcation determines the differences in the approaches to natural and anthropogenic ecosystems in their assessments. For techno-ecosystems, thus, the range of ecosystem services is greatly expanded. On the basis of this, a mechanism should be developed for assessing their ecological, or rather, environmental and technical potential, optimization and management.

We proposed a principle approach and an original methodology for assessing the ecological potential of NPP techno-ecosystems (Protasov et al., 2019). Testing this technique on the data obtained during the study of the Khmelnitsky NPP techno-ecosystem (Techno-ecosystem…, 2011) showed satisfactory results that more closely correspond to the general concept of assessing of the environmental potential of this type of water bodies. However, using of the methodology to assess the potential of another nuclear power plant, in particular the South Ukrainian NPP, led to certain difficulties. The problems are related with the definition of environmentally and technically acceptable conditions (ETAC) for this techno-ecosystem. Features of the geochemical region and conditions of operating of nuclear power plants are determined in this techno-ecosystem by ETAC, which formally fall into the area of unsatisfactory indicators. This question requires further research and further development. However, we can already conclude that, in fact, there is a gradient structure of ecosystems: from natural, not disturbed by humans, to techno-ecosystems among which there are also techno-ecosystems with varying degrees of anthropogenic impact. Thus, the separation of ecosystems to assess their condition only into two types – natural and human disturbed – was insufficient, since there is a certain gradient structure.

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BENZENE PHOTODESTRUCTION USING TI-CONTAINING CATALYSTS ON METALLIC SUPPORTS

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Very important problem nowadays is the industrial wastewater purification. Aromatic hydrocarbons (phenol and benzene, in particular) are the most common pollutants. Photocatalysis is one of the environmental friendly technologies for the reprocessing of toxic pollutants directly under the influence of solar radiation. It is known that titanium dioxide is one of the most studied and active photocatalyst. The main disadvantage of this catalyst is adsorption only UV-irradiation (i.e., wavelength<388 nm) . For the purpose of activity shift to the visible radiation range the intensive researches on TiO_2 doping by various elements including nitrogen are carried out. On the other hand the use of TiO_2 in the form of fine powder is a technological drawback. The solve of this problem may be related to the use of various supported TiO_2-containing catalysts. Synthesis of the supported on Aluminium foil and AISI 321 stainless steel foil (thickness 80 μm) composites was carried out by low temperature ion implantation method. Ti was used as an implant. The cathode sputtering of the target (Ti) was carried out by N_2 ions. The energy of implantation is 20 keV at a dose of $5x10^{17}$ ions/cm^2. The obtained samples were calcinated on air in the temperature range of 200-400 °C. The surface composition and the effect of calcination temperature were characterized by XRD, SAXS, SEM, AFM, and XPS. It was shown that as a result of ion implantation of Ti on the surface of a stainless steel, a nanosized layer of the implant is formed, in the form of amorphous composition consisting of oxide, nitride and titanium oxynitride. Hypothesis of active phases on the surface of support is expressed, which ensures its high activity in the reaction of photodegradation of an gaseous benzene under UV and visible light irradiation.